

Oct. 29, 1957

S. J. KOCH ET AL.
LOW-VOLTAGE RELAY DEVICE

2,811,603

Filed July 22, 1954

2 Sheets-Sheet 1

FIG. 1.

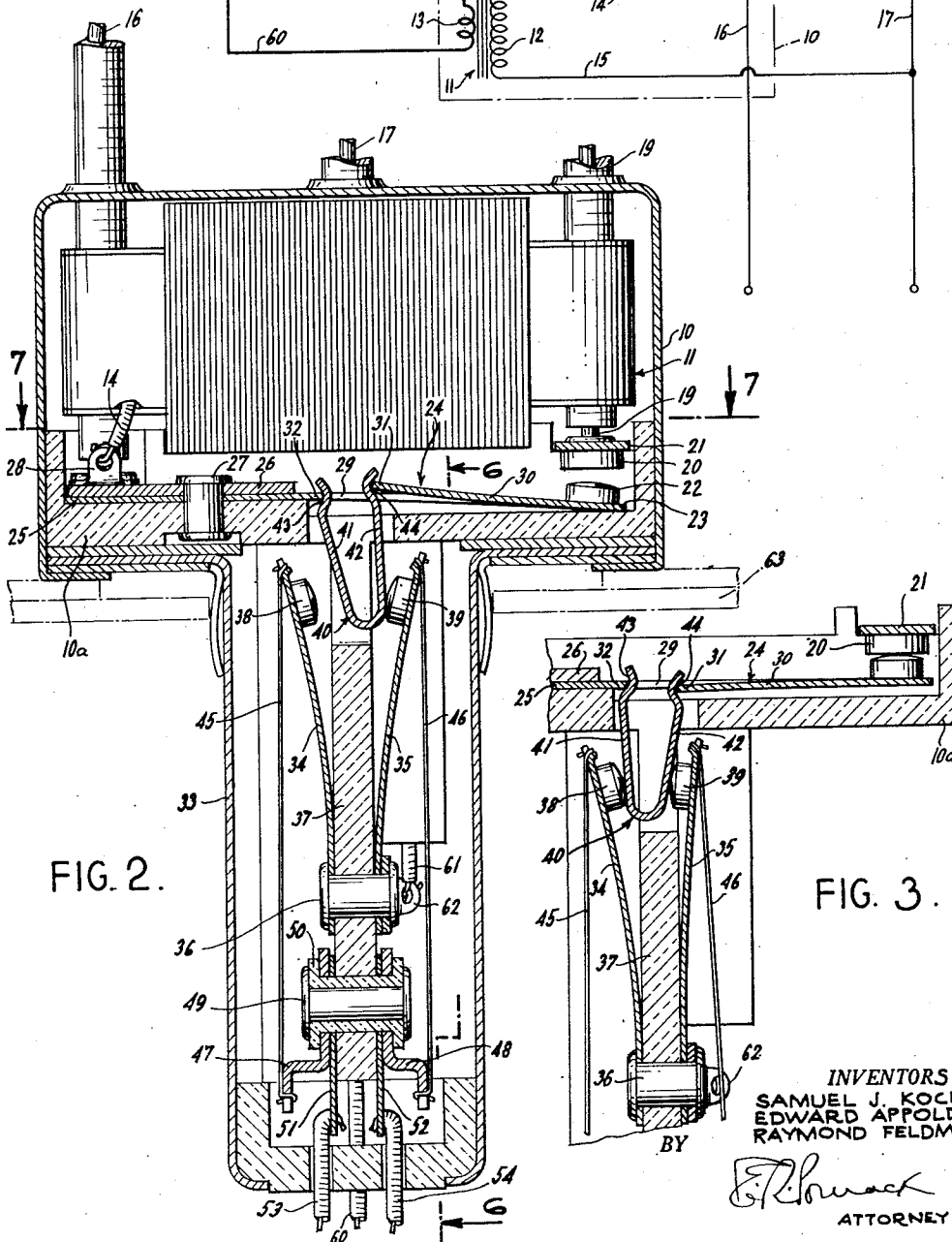
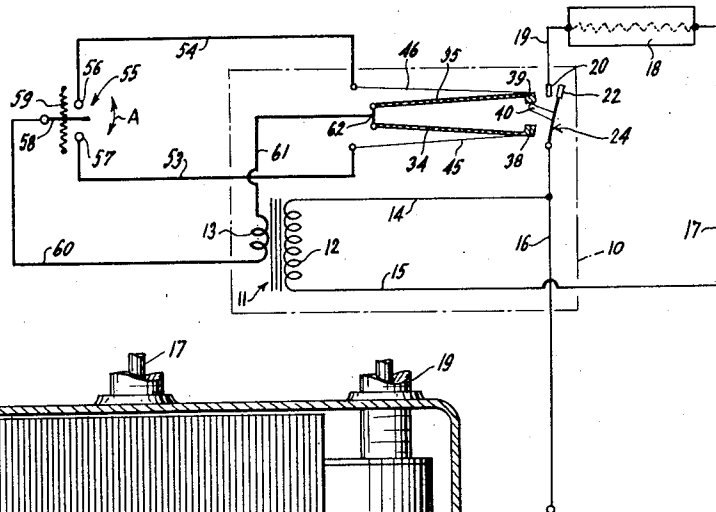


FIG. 2.

FIG. 3.

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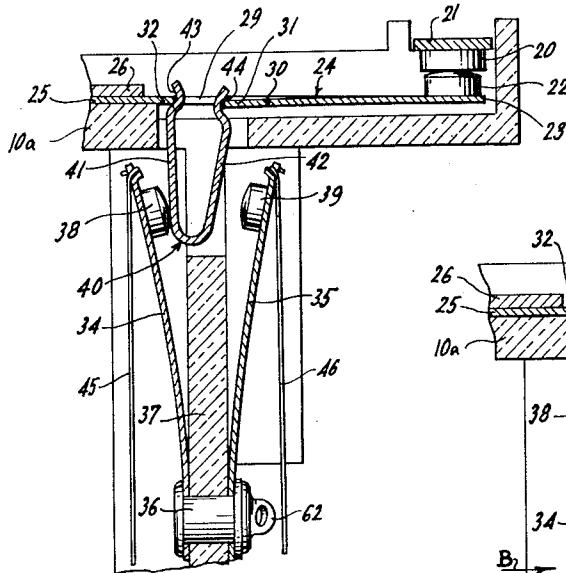


FIG. 4.

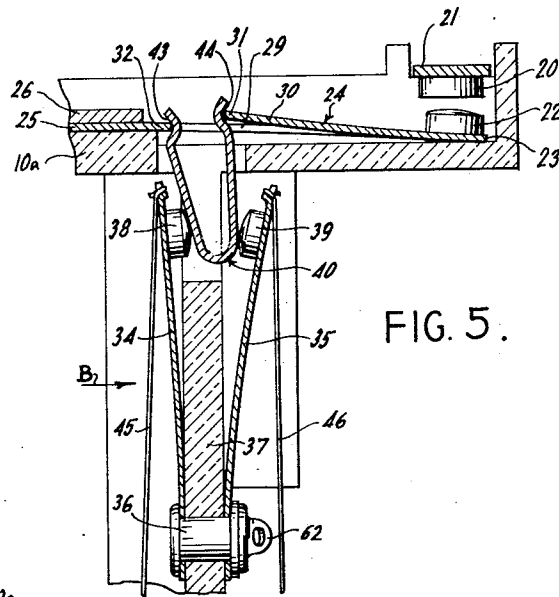


FIG. 5.

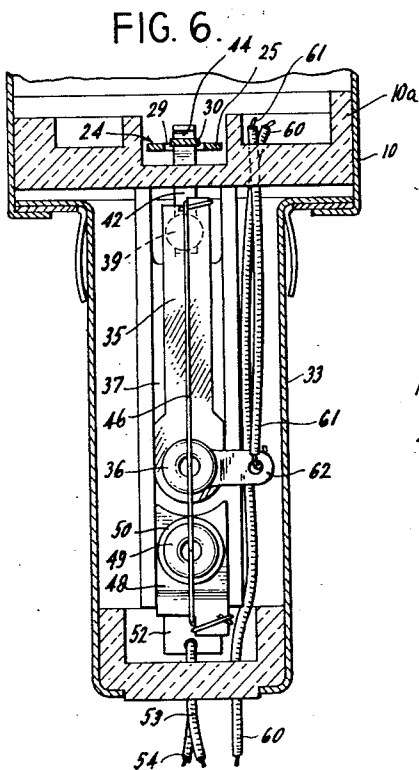


FIG. 6.

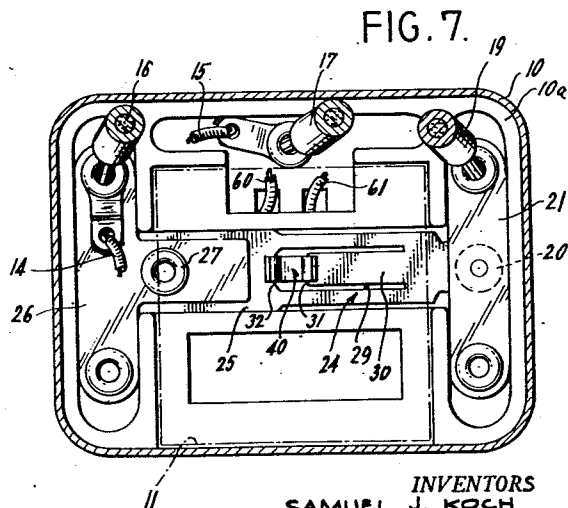


FIG. 7.

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LOW-VOLTAGE RELAY DEVICE

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Application July 22, 1954, Serial No. 445,048

6 Claims. (Cl. 200—113)

This invention relates to relay devices, more particularly to a low-voltage switch and transformer unit operable from line voltage.

In conventional installations, particularly where a number of differently located switches are operatively connected to a single fixture or other electrical appliance, or where a localized group of switches are connected to a number of different fixtures and appliances, the material and labor costs are frequently prohibitively high. Where the switches are in series with the relatively high-voltage line current, such as the usual 110 volt house current, relatively bulky and costly wire and sheathing combinations must be employed, to meet underwriters or general safety requirements. To avoid this disadvantage, other conventional systems have been devised in which a plurality of low-voltage switches are operatively connected to a central unit containing a relatively large transformer and a plurality of controlling electrical devices—the arrangement being such as to require the use of a multiplicity of low-voltage wires connected to said central unit. The making of such an installation generally entails considerable labor, and frequently involves complexities that are not within the scope of the average electrician's experience.

It is primarily within the contemplation of this invention to provide a line-current-operated low-voltage relay switch having none of the aforesaid shortcomings, and which will effectively enable either a plurality of low-voltage switches to be connected to one or more electrical appliances or fixtures, or a localized array of a number of such switches to be connected to various appliances or fixtures differently located—with a minimum of wiring, and without the need to employ a central transformer control unit. And in the accomplishment of this objective, it is a further object to provide a self-contained unitary device with the above-mentioned features, which is sufficiently compact for insertion in a wall outlet box of substantially conventional size, and which will be extremely easy to install.

It is another object of this invention to provide a fast make-and-break switch device in the line circuit on the primary side of the transformer, to meet standard safety requirements. And in the accomplishment of this objective a novel form of actuating mechanism for said high-voltage line is employed, thereby obviating the use of the conventional bulky solenoid type of make-and-break switch.

It is further within the contemplation of this invention to provide a novel arrangement of complementary expandable heating elements operable by a low-voltage current, whereby operative movements of said heating elements will cause alternate opening and closing movements of coacting contacting elements of the line circuit connected to the load, in response to selective operation of connected manually-operated low-voltage switches.

Other objects, features and advantages will appear from the drawings and the description hereinafter given.

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Referring to the drawings,

Figure 1 is a schematic representation of the electric connections between the device of our invention, a manually operable "on-off" low-voltage switch and a load, the device being shown in its normal inoperative position with the circuit through the load open.

Figure 2 is a longitudinal section through the device of our invention in the normal inoperative position thereof schematically shown in Figure 1.

Figure 3 is a fragmentary section substantially like that of Figure 2, with portions removed for clarity, the device being shown while said on-off switch is held in its "on" position, the contact points in the line circuit being shown in engagement, whereby the circuit through the load is closed.

Figure 4 is a view substantially like Figure 3 after said on-off switch has operatively returned to its neutral position, said contact points still being in operative engagement.

Figure 5 is a view substantially like Figure 3, the device being shown while said on-off switch is held in its "off" position, said contact points being shown separated.

Figure 6 is a fragmentary section of Figure 2 taken substantially along line 6—6.

Figure 7 is a section of Figure 2 taken substantially along line 7—7, with portions removed for clarity, the position of the transformer being shown by dot-dash lines.

In the form of our invention illustrated, a casing 10 supports therein the plastic non-conducting base 10a, said casing containing therein the relay transformer 11 with a line-voltage primary coil 12 and a low-voltage secondary coil 13 (Figure 1). The two primary conductors 14 and 15 are electrically connected to the conductors 16 and 17, respectively, of the line circuit, said conductor 17 being electrically connected to the load 18 and conductor 19, the latter being connected to the stationary line contact point 20 mounted on the conducting bar 21 (Figures 2 and 7). The movable contact point 22, operatively engageable with said point 20, is mounted on the free terminal 23 of the flexible metallic "snap action" arm 24, said arm having a fixed portion 25 clamped between the T-shaped conducting plate 26 and the said base 10a by the rivet 27. The said primary conductor 14 is electrically connected at 28 to said plate 26, whereby a complete line circuit can be effected through the primary 12 of the transformer, said arm 24 and said load 18 when the points 20 and 22 are in engagement.

The said arm 24 contains therein an apertured portion 29 into which extends the spring tongue 30 integral with said arm, the free end 31 of which is spaced from the innermost end 32 of said fixed portion 25. The arrangement is such that when said tongue 30 is operatively actuated upwardly (in a manner to be hereinafter set forth) the free terminal portion 23 of arm 24 is snapped downwardly to the lower limiting position shown in Figures 2 and 5, to cause a separation of said contact points 20 and 22, to open the circuit through load 18; and conversely, when said tongue is operatively actuated downwardly, said free terminal portion 23 of said arm is snapped upwardly to bring said contact points 20 and 22 into engagement, as shown in Figures 3 and 4, to close the circuit through the load.

The means for accomplishing the engagement and disengagement of said contact points 20 and 22, and the consequent making and breaking of the line circuit operatively connected to said load—which may be an electric light, an appliance or other electrical device—is a low-voltage thermal expansion wire relay disposed within the elongated casing 33 extending into and secured to said casing 10. Said relay device comprises, among other elements, the two opposite flat fingers 34 and 35, made of

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conducting material and secured by rivet 36 to the insulating frame 37—said spring fingers carrying thereon the non-conducting buttons 38 and 39, respectively. Said buttons are positioned for operative engagement with the substantially U-shaped contact arm actuator 40 suspended from said snap action arm 24 and extending into said casing 33 between said buttons 38 and 39. The legs 41 and 42 of said actuator 40 have their upper portion indented toward each other, to form two opposite recessed portions 43 and 44, respectively, engaging the said innermost end 32 of the fixed portion of arm 24, and the said free end 31 of said tongue.

The arrangement is such that actuator 40 is movable between two limiting positions—the extreme right position of Figures 2 and 5, and the extreme left position of Figures 3 and 4. When the actuator is in said right position, said tongue 30 is operatively raised, to separate said contacts 20 and 22; and when the actuator is in said left position, said tongue is depressed, to bring the contacts into engagement. As will more clearly hereinafter appear, the actuator is moved to its said two limiting positions by said buttons 38 and 39—the said operative movements of the actuator 40 being toggle-like in effect—causing snap action movements of said arm 24, and thereby producing quick make and break actions of said contacts 20 and 22—a highly desirable condition for contacts in a circuit of the voltages usually carried by house lines.

Connected to said spring fingers 34 and 35 are the respective thermal expansion wires 45 and 46, attached to conducting anchors 47 and 48, respectively, secured by rivet 49 and insulating grommet 50 to the respective conducting plates 51 and 52 and said insulating frame 37 (Figure 2). Conductor 53 is connected to plate 51, and conductor 54 is connected to plate 52, said last-mentioned conductors being electrically connected to the opposite poles of the low-voltage on-off switch 55 schematically shown in Figure 1. Said switch has an "on" terminal 56, an "off" terminal 57, and a switch arm 58 operatively movable for selective contacting with said terminals 56 and 57, as indicated by the arrows A. In the preferred arrangement illustrated, said arm 58 is spring loaded and normally maintained in a neutral position, as by spring means 59—so that when said switch arm 58 is manually brought into engagement with either of said terminals 56 or 57 and then released, the arm will return to said neutral non-contacting position—whereby only a temporary engagement between said switch arm and either of said terminals is effected. Said arm is electrically connected by conductor 60 to the secondary 13 of transformer 11, the opposite end of secondary 13 being connected by conductor 61 to the common terminal 62 electrically connected through said rivet 36 to both of said spring fingers 34 and 35.

The thermal expansion wires 45 and 46, and the spring fingers 34 and 35 to which they are attached, are so proportioned that when said wires are cold and in their operatively contracted condition, the said fingers 34 and 35 are held in outwardly flexed positions by said wires, whereby the buttons 38 and 39 are in their outermost or inoperative positions, as shown in Figures 2 and 4. When a current is operatively passed through either of said wires 45 or 46, the wire expands, permitting the spring finger to which it is attached to return to its normal substantially unflexed position, whereby the corresponding button is also brought inwardly to engage the actuator 40. For example, if a current is passed through wire 45, its consequent expansion will enable spring finger 34 to straighten out and move to the right in the direction of arrow B (Figure 5), whereby the button 38 is enabled to engage the actuator 40 and move it to the position indicated in Figure 5, from its previous position indicated in Figure 4. Similarly, when a current is operatively passed through wire 46, its expansion permits the spring finger 35 to return to its substantially unflexed position, as indicated in Figure 3, thereby permitting the button 39 to engage said

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actuator 40 and move it to the position indicated in Figure 3 from its previous position of Figure 2.

In operatively employing the device of our invention, it is inserted, in the usual way, in an outlet box, such as box 63 indicated by the dot-dash lines of Figure 2, the casing 33 being positioned in a suitable aperture within the wall. The said low-voltage switch 55 is placed in any convenient location, with the relatively thinly encased wire conductors 53, 54 and 60 connecting said switch 55 to the device of our invention at the points hereinabove indicated—the wires 14, 15 and 19 being connected to the conductors 16 and 17 of the line circuit, and the load 18, respectively. The device is now in condition for operation.

Normally, when the load is inoperative, the device and the connections are as indicated in Figures 1 and 2. To close the circuit through load 18, the arm 58 of switch 55 is moved to the "on" terminal 56. This closes the low-voltage output circuit through the secondary 13, the thermal expansion wire 46, and spring finger 35. The consequent expansion of the wire 46 causes the spring finger 35 to straighten out and operatively move the actuator 40 from its position of Figure 2 to the position of Figure 3, thereby bringing the contact points 20 and 22 into operative engagement, and closing the circuit through the load 18. When said spring-loaded arm 58 of switch 55 is released, it will return to its normal neutral position shown in Figure 1, thereby causing an opening of the circuit through wire 46 and the consequent cooling and contraction of said wire, to urge the spring finger 35 into its outwardly flexed position as shown in Figure 4. The circuit through the load 18 will remain closed until the said arm 58 of switch 55 is moved into engagement with the "off" terminal 57 of said switch. When this occurs, the circuit is closed through the secondary 13, the spring finger 34 and the thermal expansion wire 45, to cause the latter to expand and thereby permit the spring finger 34 to straighten out to the position shown in Figure 5, whereby the button 38 engages actuator 40 to bring it to the position shown in Figure 5, whereby the contact points 20 and 22, as aforesaid, are separated to cause an opening of the circuit through load 18. When the spring-loaded arm 58 of switch 55 is released, it will again return to its normal position shown in Figure 1, in the manner aforesaid, causing an opening of the circuit through the wire 45 and an operative contraction thereof, to bring the spring finger 34 back to its flexed position shown in Figure 2.

The above-described cycle of operations can thus be effected by our unitary device, without the need to employ wall switches directly connected to the line current, nor a multiplicity of heavily sheathed wires connected to a central transformer unit. The thinly sheathed wires 53, 54 and 60 can safely be employed with the manually operated switch 55, without the use of bulky and expensive protective conduits or pipes. Because of the use of said thinly sheathed wires 53, 54 and 60 in conjunction with the low-voltage switch 55, not only is the use of such a switch rendered completely safe for manual use, but it is extremely economical of space. Indeed, it is possible with our arrangement to have a plurality of switches, like 55, operatively connected to different appliances, all switches on one relatively small panel. And it is also possible, with our device, to have a number of low-voltage switches like 55 located in different localities and all connected to a single load, without the need to employ bulky and expensive wire and casing conduits.

In the above description, the invention has been disclosed merely by way of example and in preferred manner; but obviously many variations and modifications may be made therein. It is to be understood, therefore, that the invention is not limited to any specific form or manner of practicing same, except insofar as such limitations are specified in the appended claims.

We claim:

1. In a relay device, a casing, a stationary contact element within said casing, a metallic spring arm having a

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free terminal portion and an opposite portion fixedly mounted within said casing, a second contact element carried by said free terminal portion and positioned for engagement with said stationary contact element, said free terminal portion being movable between two limiting positions, said contact elements being in engagement when said terminal portion is in one of said two positions and out of engagement when in the other of said two positions, said arm having an apertured portion therein and a spring tongue extending into said apertured portion, a substantially U-shaped actuator having two legs extending through said apertured portion and in operative engagement with said tongue and a wall of said aperture, said actuator being movable between two opposite extreme positions, said free terminal portion of the arm being in one of its said limiting positions when the actuator is in one of its said extreme positions and in the other of its said limiting positions when the actuator is in the other of its said extreme positions, two electrically conductive flexible spring fingers, an insulating mounting for said fingers, said fingers having free terminal portions carrying thereon non-conductive buttons, said free terminal portions with the respective buttons thereon flanking said actuator and each movable between an operative and an inoperative limiting position, each of said fingers being normally yieldably urged toward its said operative position, said buttons being respectively disposed adjacent said actuator when it is in its respective extreme positions, said fingers being proportioned and said buttons positioned for the respective engagement of said buttons with said legs of said actuator operatively to move the actuator to the opposite of its said two extreme positions when said fingers are operatively moving to their respective operative positions, a thermal expansion wire in tensioning engagement with each of said fingers and proportioned to hold it flexed outwardly in its said inoperative position when the wire is in its operatively non-expanded position, said respective wires being electrically connected to said flexible fingers, a common connector on said insulating mounting electrically joining said fingers, each of said wires being operatively expandable to permit the finger operatively engaged thereby yieldably to return to its operative position.

2. In a self-contained unitary relay device for partial insertion in an apertured wall outlet box, a first casing proportioned for positioning within said box, a second relatively narrow elongated casing proportioned to extend through the apertured portion of said outlet box, said second casing being attached to and communicating with said first casing, an elongated spring-loaded finger extending longitudinally in said second elongated casing, said finger being movable between an operative and an inoperative limiting position, a thermal expansion wire in tensioning engagement with said finger and proportioned to hold it in one of its said limiting positions, electrical conducting means connected to said wire, said wire being expandable when a current is operatively passed therethrough, whereby the wire will operatively expand and permit said finger to move to the other of its said limiting positions, contact actuating means operatively engageable with said finger and movable between two limiting positions upon the operative movement of said finger between its said two limiting positions, and contact means in said first casing and operatively connected to said actuating means.

3. In a self-contained unitary relay device for partial insertion in an apertured wall outlet box, the combination according to claim 2, said first casing having an apertured portion communicating with said second casing, said contact actuating means extending through said last-mentioned apertured portion and having sections disposed in both of said casings.

4. In a self-contained unitary relay device for partial insertion in an apertured wall outlet box, a first casing proportioned for positioning within said box, a second relatively narrow elongated casing proportioned to ex-

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tend through the apertured portion of said outlet box, said second casing being attached to and communicating with said first casing, a stationary contact element within said first casing, a conductor extending from said contact element, a metallic spring arm having a free terminal portion and an opposite portion fixedly mounted in said first casing, a second contact element carried by said free terminal portion and positioned for engagement with said stationary contact element, said free terminal portion of the arm being movable between two limiting positions, said contact elements being in engagement when said terminal portion is in one of said two positions and out of engagement when in the other of said two positions, an actuator in engagement with said arm and extending through said first casing into said second casing, said actuator being movable between two opposite extreme positions, said free terminal portion of the arm being in one of its said limiting positions when the actuator is in one of its said extreme positions and in the other of its said limiting positions when the actuator is in the other of its said extreme positions, two electrically conductive flexible spring fingers within said second casing, an insulating mounting for said fingers, said fingers having free terminal portions carrying thereon non-conductive buttons, said free terminal portions with the respective buttons thereon flanking said actuator and each movable between an operative and an inoperative limiting position, each of said fingers being normally yieldably urged toward its said operative position, said buttons being respectively disposed adjacent said actuator when it is in its respective extreme positions, said fingers being proportioned and said buttons positioned for the respective engagement of said buttons with said actuator operatively to move it to the opposite of its said two extreme positions when said fingers are operatively moving to their respective operative positions, a thermal expansion wire in tensioning engagement with each of said fingers and proportioned to hold it flexed outwardly in its said inoperative position when the wire is in its operatively non-expanded position, electric conducting means connected to said flexible fingers, each of said wires being operatively expandable upon the operative passage of a current therethrough to permit the finger operatively engaged thereby yieldably to return to its operative position, said contact-carrying arm having an apertured portion therein and a spring tongue extending into said apertured portion, said actuator being substantially U-shaped with two legs extending through said last-mentioned apertured portion and in operative engagement with said tongue and a wall of said aperture, said respective buttons being operatively engageable with the opposite legs of said U-shaped actuator.

5. In a self-contained unitary relay device for partial insertion in an apertured wall outlet box, a first casing proportioned for positioning within said box, a second relatively narrow elongated casing proportioned to extend through the apertured portion of said outlet box, said second casing being attached to and communicating with said first casing, a stationary contact element within said first casing, a conductor extending from said contact element, a metallic spring arm having a free terminal portion and an opposite portion fixedly mounted in said first casing, a second contact element carried by said free terminal portion and positioned for engagement with said stationary contact element, said free terminal portion of the arm being movable between two limiting positions, said contact elements being in engagement when said terminal portion is in one of said two positions and out of engagement when in the other of said two positions, an actuator in engagement with said arm and extending through said first casing into said second casing, said actuator being movable between two opposite extreme positions, said free terminal portion of the arm being in one of its said limiting positions when the actuator is in one of its said extreme positions and in the other

of its said limiting positions when the actuator is in the other of its said extreme positions, two electrically conductive flexible spring fingers within said second casing, an insulating mounting for said fingers, said fingers having free terminal portions carrying thereon non-conductive buttons, said free terminal portions with the respective buttons thereon flanking said actuator and each movable between an operative and an inoperative limiting position, each of said fingers being normally yieldably urged toward its said operative position, said buttons being respectively disposed adjacent said actuator when it is in its respective extreme positions, said fingers being proportioned and said buttons positioned for the respective engagement of said buttons with said actuator operatively to move it to the opposite of its said two extreme positions when said fingers are operatively moving to their respective operative positions, a thermal expansion wire in tensioning engagement with each of said fingers and proportioned to hold it flexed outwardly in its said inoperative position when the wire is in its operatively non-expanded position, electric conducting means connected to said flexible fingers, each of said wires being operatively expandable upon the operative passage of a current therethrough to permit the finger operatively engaged thereby yieldably to return to its operative position, said insulating mounting having two anchorage members attached thereto, said two thermal expansion wires being connected to said anchorage members, respectively.

6. In a self-contained unitary relay device for partial insertion in an apertured wall outlet box, a first casing proportioned for positioning within said box, a second relatively narrow elongated casing proportioned to extend through the apertured portion of said outlet box, said second casing being attached to and communicating with said first casing, a stationary contact element within said first casing, a conductor extending from said contact element, a metallic spring arm having a free terminal portion and an opposite portion fixedly mounted on said first casing, a second contact element carried by said free terminal portion and positioned for engagement with said stationary contact element, said free terminal portion of the arm being movable between two limiting positions, said contact elements being in engagement when said terminal portion is in one of said two positions and out of engagement when in the other of said two positions, an actuator in engagement with said arm and extending through said first casing into said second casing, said actuator being movable between two opposite extreme

positions, said free terminal portion of the arm being in one of its said limiting positions when the actuator is in one of its said extreme positions and in the other of its said limiting positions when the actuator is in the other of its said extreme positions, two electrically conductive flexible spring fingers within said second casing, an insulating mounting for said fingers, said fingers having free terminal portions carrying thereon non-conductive buttons, said free terminal portions with the respective buttons thereon flanking said actuator and each movable between an operative and an inoperative limiting position, each of said fingers being normally yieldably urged toward its said operative position, said buttons being respectively disposed adjacent said actuator when it is in its respective extreme positions, said fingers being proportioned and said buttons positioned for the respective engagement of said buttons with said actuator operatively to move it to the opposite of its said two extreme positions when said fingers are operatively moving to their respective operative positions, a thermal expansion wire in tensioning engagement with each of said fingers and proportioned to hold it flexed outwardly in its said inoperative position when the wire is in its operatively non-expanded position, electric conducting means connected to said flexible fingers, each of said wires being operatively expandable upon the operative passage of a current therethrough to permit the finger operatively engaged thereby yieldably to return to its operative position, said insulating mounting having two anchorage members attached thereto, said two thermal expansion wires being connected to said anchorage members, respectively, said anchorage members being spaced relative to said respective spring fingers to maintain said wires in tension against the yieldable action of said fingers.

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